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REPORT TO THE GOVERNOR AND 76th GENERAL ASSEMBLY

LAKE MICHIGAN OPEN WATER AND LAKE BED SURVEY 1969

Illinois Sanitary Water Board — June, 1970

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1969

SURVEYS OF LAKE MICHIGAN

OPEN WATER QUALITY AND LAKE BED

REPORT TO

THE GOVERNOR

AND

76TH GENERAL ASSEMBLY

Prepared for Sanitary Water Board
in cooperation with Illinois Department of Public Health
June 1970

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THE BOARD
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SPRINGFIELD

TECHNICAL SECRETARY
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CHIEF SANITARY ENGINEER
DEPARTMENT OF PUBLIC HEALTH

ADDRESS LETTERS TO
STATE SANITARY WATER BOARD
SPRINGFIELD, ILLINOIS
62706

June 22, 1970

The Honorable Richard B. Ogilvie
Governor, State of Illinois

Honorable Members of the 76th
General Assembly, State of Illinois

Members of the Illinois Sanitary Water Board

Gentlemen:

Pursuant to Senate Bill 1794, 75th General Assembly, the Illinois Sanitary Water Board staff conducted water quality and lake bed surveys during 1969 to evaluate the ecology and quality of the open water in Lake Michigan. Data obtained during these surveys, and conclusions based thereon are presented in this report and compared with 1968 survey results.

This report also summarizes action taken to control, to improve or to eliminate discharges of wastes to Lake Michigan, in order to assure compliance with the Illinois Water Quality Standards for Lake Michigan.

In general, the 1969 survey data indicates that the Lake Michigan open water was of somewhat better quality than found during 1968. The Summary on page 1, shows that of the twenty-one water quality parameters for which data were obtained, sixteen complied with the applicable standards, only five exceeded the established limits. Five parameters indicated better water quality during 1969, four indicated poorer quality.

In addition to the survey data discussed above, special surveys were conducted in the U. S. Established Dumping Area. This area located about ten miles off shore was not sampled during the 1968 survey. Except for chloride levels, all of the open water standards were met during 1969. The chloride level in this area however was comparable to that which prevailed elsehwere. The State of Illinois has not granted permits for dumping since passage of Senate Bill 1794 in 1967.

Slightly more than half (58%) of the lake bed stations sampled were considered representative of a degraded ecological environment; these stations were located in four general areas. These data and evaluations are presented in the report, starting on page 29.

A separate report transmitted to the 76th General Assembly during April 1970, related to surveys of Lake Michigan Shore (beach) water during 1969.

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Continued monitoring of water quality and surveys of bottom deposits and ecology are necessary in order to evaluate the effectiveness of the control measures implemented by the State of Illinois and neighbor lake states to control, to improve, and to eliminate discharge of wastes to Lake Michigan by municipalities and industries.

Summaries of projects and accounts of dollars spent may be impressive, however, the actual quality of the water and of the ecology as found during these surveys are graphic evidence as to whether progress is being made in the battle to "Save Lake Michigan."

Very truly yours,

Franklin D Yoder

Franklin D. Yoder, M.D., Chairman
Illinois Sanitary Water Board

CW Klassen

C. W. Klassen, Technical Secretary
Illinois Sanitary Water Board

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SUMMARY

OPEN WATER QUALITY AND LAKE BED SURVEYS

Open water samples were collected monthly at five selected municipal filtration plants; supplementary samples were obtained during nine water quality boat cruises. Bottom dredge samples were obtained at sixty stations during ten boat sampling surveys.

Results of chemical and bacteriological analyses, together with data obtained from the bottom dredge samples were compared to the Water Quality Standards, Rules and Regulations, SWB-7.

Of the twenty-one water quality parameters for which data were obtained, sixteen complied with the applicable standards, while five exceeded the established limits, as follows:

COLIFORM AND FECAL STREPTOCOCCI bacterial counts complied with the standards. In both cases, counts were somewhat lower than during 1968.

ODOR, OIL, FLOATING SOLIDS AND DEBRIS complied with the standards.

CYANIDES in detectable concentrations were not found.

TEMPERATURE, pH AND DISSOLVED OXYGEN concentrations complied with the standards.

FLUORIDES, PHENOL-LIKE SUBSTANCES AND RADIONUCLIDES concentrations complied with the standards; there were no appreciable changes from 1968.

TURBIDITY, while in general compliance, increased considerably from 1968.

METHYLENE BLUE ACTIVE SUBSTANCE, DISSOLVED IRON AND SULFATES concentrations met the standards, and decreased from 1968 levels. Dissolved iron and MBAS concentrations exceeded the standards in 1968.

TOTAL PHOSPHATES concentrations exceeded the standards, and increased slightly from 1968 levels.

AMMONIA NITROGEN concentrations, while exceeding the standards, decreased slightly from 1968.

CHLORIDES AND FILTRABLE RESIDUE concentrations, which were in compliance in 1968, exceeded the standards during 1969.

BOTTOM DEPOSITS - Slightly more than fifty percent of the lake bed stations sampled were considered representative of a degraded ecological environment.

The data obtained during the 1969 survey indicates that the Lake Michigan open water was of somewhat better quality than during 1968.

Figure 1

LOCATIONS OF MUNICIPAL WATER FILTRATION PLANT RAW WATER INTAKES, BOTTOM DREDGE STATIONS AND INDUSTRIES WITH DISCHARGES TO LAKE MICHIGAN

ZION TO EVANSTON

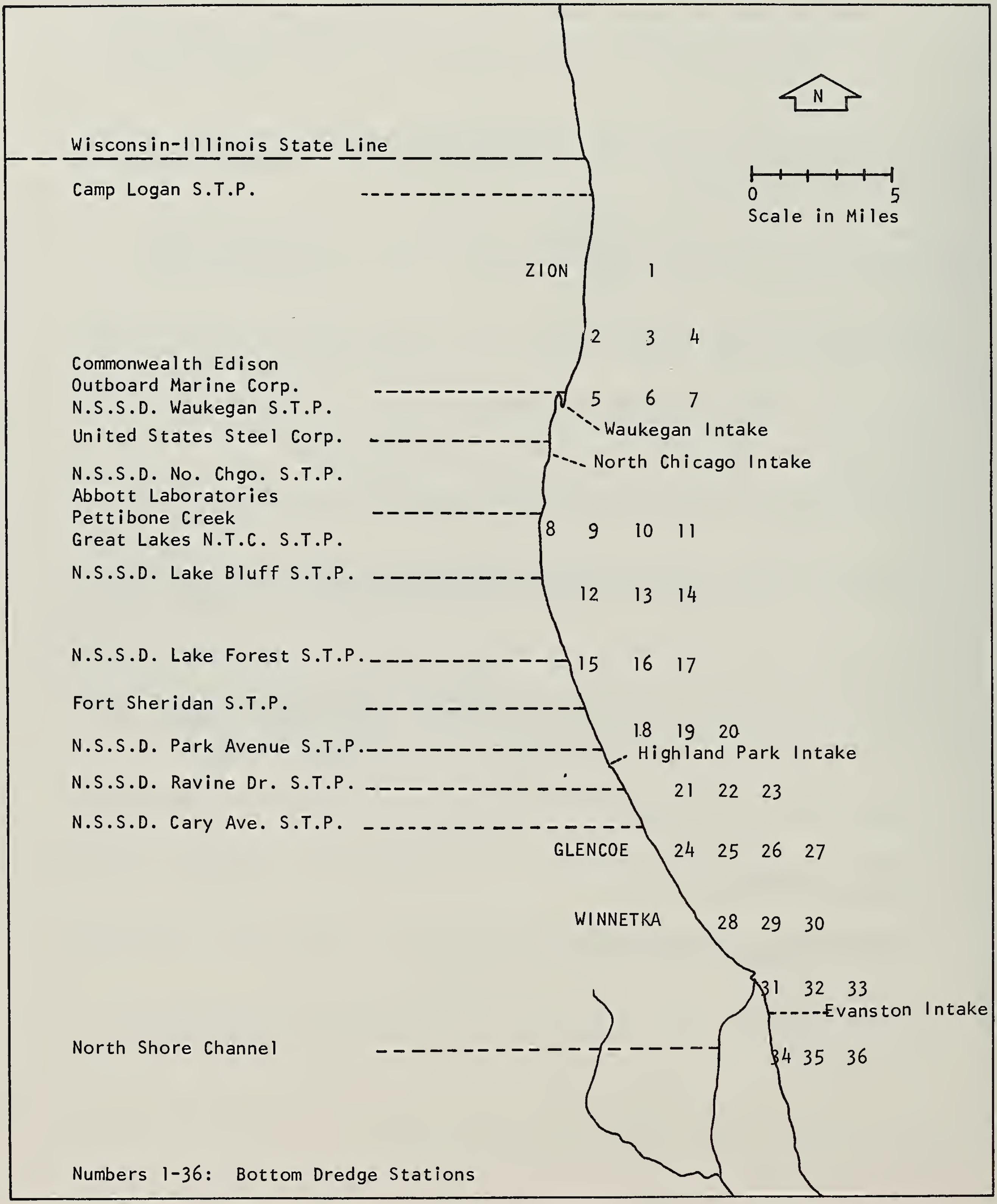
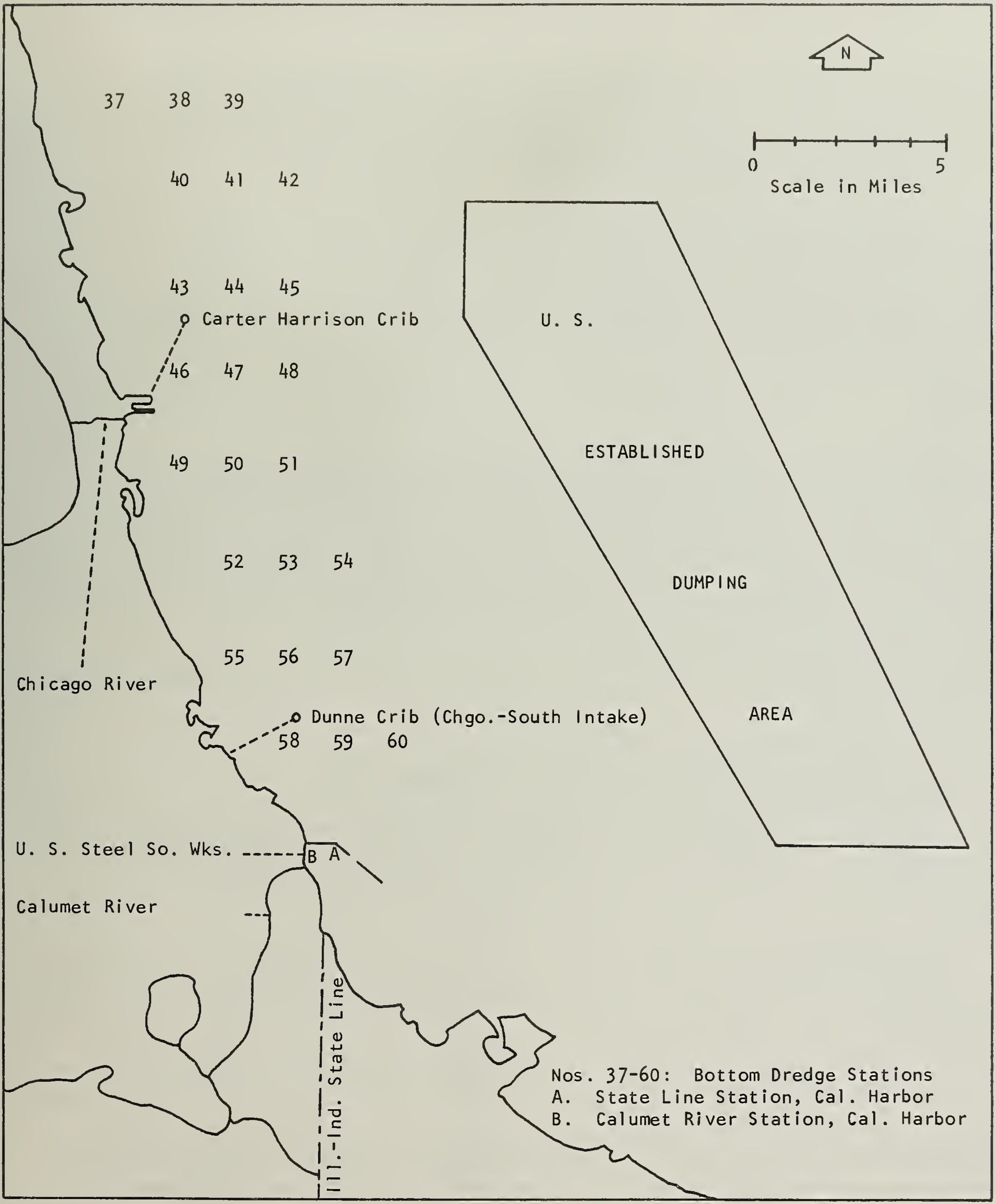


Figure 2

LOCATIONS OF RAW WATER INTAKE CRIBS, CALUMET HARBOR SAMPLE STATIONS, BOTTOM DREDGE STATIONS AND U. S. ESTABLISHED DUMPING AREA
CHICAGO



WATER MONITORING PROGRAM

GENERAL INFORMATION

The water monitoring data relates to three areas: (1) Open Water, (2) U. S. Established Dumping Area, and (3) Calumet Harbor. Descriptions of these areas, and of the methods of collection and frequency of sampling are presented in the following sections.

Water Quality Standards for Lake Michigan, Rules and Regulations, SWB-7, adopted by the Illinois Sanitary Water Board, serve as the basis for evaluation of 1969 monitoring results in the Open Water and U. S. Established Dumping Area sections of this report. Water quality standards for Calumet Harbor are included in Rules and Regulations, SWB-15.

Personnel in the Division of Sanitary Engineering of the Illinois Department of Public Health collected the samples. Samples were kept on ice during warm weather months. Samples were delivered to the Chicago Branch Laboratory of the Department for chemical and bacteriological analyses. A boat was furnished by the Illinois Division of Waterways for collection of samples to supplement those obtained from intakes at municipal water filtration plants.

OPEN WATER

The raw water intakes at the municipal water filtration plants which utilize Lake Michigan as their source of water supply have been designated in SWB-7 as the control points for monitoring the quality of Lake Michigan open waters. Five plants were selected for the 1969 monitoring program, namely: Waukegan, North Chicago, Highland Park, Evanston and Chicago-South. Samples of water from the raw water intakes at these plants were scheduled for monthly collection. Information on intakes at these plants is presented in Table 1. During 1968, raw water samples collected at the Chicago-South plant were a mixture of shore and crib (open) waters. During 1969, the raw water samples were taken directly from the crib intake and, therefore, were representative of the open waters.

TABLE 1

WATER FILTRATION PLANTS MONITORED DURING 1969

Name of Plant	Number of Intakes	Distance of Intake From Shore (ft.)	Water Depth Over Intake (ft.)
Waukegan	2	Shore	--
		6,200	35
North Chicago	1	6,500	28
Highland Park	3	1,000	18
		2,000	18
		3,500	10
Evanston	3	1,800	16
		2,600	18
		5,600	28
Chicago-South	2	Shore	--
		10,000	32

In addition, nine sampling cruises were made during the period from May through October. These samples were collected at the following locations: (1) two miles off shore from Zion; (2) near the intake ends of the raw water lines serving the Waukegan, Highland Park and Evanston water filtration plants, and (3) near the City of Chicago's Carter Harrison and Dunne Cribs. SWB-7 does not call for boat sampling.

U.S. ESTABLISHED DUMPING AREA

An area in Lake Michigan has been designated by the United States Government for the dumping of harbor dredgings and other material. This area, located approximately ten miles east of the Illinois shore, between Montrose Avenue extended and 74th Street extended, and about five miles wide, is shown in Figure 2. Senate Bill 1794, adopted by the 75th Illinois General Assembly, effective October 30, 1967, prohibits issuance of permits by the Illinois Division of Waterways, for the depositing of rock, earth, sand or other material or any refuse matter of any kind or description in Lake Michigan, except with the concurrence of the Sanitary Water Board. During 1969, Sanitary Water Board concurrences were granted only for placing of steel sheeting and piling and concrete used in jetties, groins and bulwarks to protect the shore; no concurrences were granted for placing of any other materials.

Three boat trips were made to the dumping area during the May through October, 1969 period. Samples were collected near two marker buoys located approximately at the northwest and southwest corners of the area. Surface and bottom water samples collected at the dumping area, were composited for analyses and examination, except for those related to temperature, dissolved oxygen and phytoplankton. SWB-7 Open Water Standards were used to evaluate these data. Water samples were not collected at the dumping area during 1968.

CALUMET HARBOR

Water in Calumet Harbor was sampled during four boat cruises in the May through October, 1969 period. Water in Calumet Harbor was not sampled during 1968.

Samples were collected at two stations, located: (A) at the Illinois-Indiana State line, about 20 yards south of the breakwater and (b) at the mouth of the Calumet River (Figure 2).

FACTORS INFLUENCING OPEN WATER QUALITY

The monitoring of shore waters reflects the influence of recent hydrologic conditions and localized human activities. In contrast, the monitoring of open waters reflects long-term changes resulting from activities and conditions within a major portion of the Lake Michigan watershed.

The term "open water" is a relative term; the farther from shore that a water sample originates, the more representative it becomes of open water.

It should be noted that the intakes of the water plants sampled in 1969 are not all located at the same distances from shore. Normally, along the Illinois shore, mixing between shore waters and off shore waters occurs slowly and to a limited extent. Current velocity gradients and water quality gradients also exist along the edge of the lake. Due to these conditions, it is possible that differences in water quality may exist between plants due to the location of the water intakes within different current and flow patterns.

Industrial wastes and sewage treatment plant effluents discharged to Lake Michigan in the Calumet industrial areas of Indiana and Illinois, and in Lake County, Illinois, affect the quality of Illinois shore water. Additional information with respect to these discharges is presented in the latter portions of this report.

Variations in the water quality with time may reflect changes in lake dynamics occurring at the time of sampling. During most of the year, from about April to November, the lake is thermally stratified due to density differences between the warmer surface waters and the colder deep water layers.

Stratification is destroyed during the late fall and spring overturns, resulting in thorough mixing of the lake waters. During these overturns, there is an apparent increase in the turbidity and mineral content of the open waters.

An effluent discharged during the period when the lake is thermally stratified may take one of several routes within the lake. Depending upon its density, as influenced by temperature and solids content, it may flow out along the surface and be transported by shore currents, or it may sink to the bottom or some intermediate depth, and there flow towards the open waters. Due to stratification, the effluent may avoid detection until such time as a seiche or "internal wave" in the lake brings the effluent-bearing strata to the same depth as the water intakes.

OPEN WATER MONITORING

RESULTS AND EVALUATION

COLIFORM BACTERIA (Indicators of contamination, usually by sewage or storm run-off)

Standard: Annual Average (Arithmetic) - not more than 200 per 100 ml.
Single Daily Value or Average - not more than 2,500 per 100 ml.

The coliform bacteria counts met the standards at all five municipal filtration plants during 1969.

No counts exceeded the limit for single daily values, nor did the annual averages exceed the standard. The annual averages at the four North Shore plants decreased considerably from 1968. The Chicago-South plant had a higher annual average coliform count during 1969; however, this count was still within the standard. The maximum single daily counts decreased during 1969 at the North Chicago, the Highland Park and the Chicago-South plants, while the maximum counts increased at Waukegan and Evanston.

The coliform bacteria counts in the open waters improved slightly from 1968.

FECAL STREPTOCOCCI (Indicators of recent contamination by sewage)

Standard: Not more than 25 per 100 ml.

Fecal Streptococci counts in the open waters were in general compliance with the standard in 1969.

The standard was exceeded once each at Waukegan and Highland Park; these samples represented less than 4% of the total number of samples collected at the five plants during all of 1969. Maximum values were lower at all plants during 1969 except at the Waukegan plant, where the maximum fecal streptococci count increased slightly. The greatest improvement was noted at Evanston where the maximum value decreased from 120/100 ml. (1968) to 24/100 ml (1969).

Fecal streptococci counts in the open waters were slightly lower during 1969.

TABLE 2

BACTERIA COUNTS

Water Filtration Plants	Coliform Maximum Count*	Coliform Average Count*	No. of Samples	FECAL STREPTOCOCCI No. of Samples Exceeding Standard	FECAL STREPTOCOCCI Maximum Count*
Waukegan	420	76	11	1	62
North Chicago	280	65	12	0	2
Highland Park	350	85	12	1	30
Evanston	800	93	12	0	24
Chicago-South	1,400	161	9	0	2
SWB-Limits: Not more than	2,500	200			25

*Expressed as numbers of bacteria per 100 milliters.

TURBIDITY

Standard: No turbidity of other than natural origin that will cause substantial visible contrast with the natural appearance of water.

Turbidity levels showed a marked increase at all filtration plants in 1969 except at the Chicago-South plant, where the levels were lower than in 1968.

TABLE 3

TURBIDITY LEVELS
(Jackson Turbidity Units)

WATER FILTRATION PLANT	MAXIMUM	MINIMUM	ANNUAL AVERAGE
Waukegan	35	5	14
North Chicago	52	5	15
Highland Park	46	5	20
Evanston	38	5	17
Chicago-South	22	3	8.6

ODOR

Standard: No obnoxious odor of other than natural origin.

There were no significant odors in the 1969 raw water samples from the filtration plants. Only natural odors, commonly associated with lake water, were detected during the boat sampling surveys.

OIL

Standard: Substantially free of visible floating oil.

Oil was not apparent in any of the samples collected from the filtration plants in 1969, nor were significant amounts of oil found during off shore boat sampling surveys.

FLOATING SOLIDS AND DEBRIS

Standard: Substantially free of floating solids and debris from other than natural sources.

The open waters were in compliance with the standard during 1969. During only one boat sampling cruise were "floating solids and debris from other than natural sources" noted. On July 30, 1969, a windrow consisting of numerous sea gull feathers, dead and dying alewives, and rust-red minute fines was observed about seven miles east of Calumet Harbor.

TEMPERATURE

Standard: Not more than 85°F.

During 1969, water temperature measurements at all five filtration plants complied with the standard. The maximum recorded temperature was 73°F which was recorded at Highland Park.

TABLE 4

TEMPERATURE LEVELS

WATER FILTRATION PLANT	MAXIMUM °F	MINIMUM °F	ANNUAL AVERAGE °F
Waukegan	67	33	45
North Chicago	59	33	44
Highland Park	73	34	50
Evanston	68	33	48
Chicago-South	70	40	55
SWB-7 Limit: Not more than	85		

HYDROGEN ION CONCENTRATION - pH (Indicator as to whether water is acid, neutral or alkaline)

Standards: Annual Median - within range 8.1 - 8.4
Daily Median - within range 7.7 - 9.0

pH values were within the standards during 1969.

The pH values during 1969 remained generally unchanged from 1968.

TABLE 5

pH RANGE

	WATER FILTRATION PLANT		BOAT SAMPLES Surface		BOAT SAMPLES Bottom	
LOCATION	Range of Daily Median Values	Annual Median	Range of Daily Median Values	Annual Median	Range of Daily Median Values	Annual Median
Zion	- -	-	8.3 - 8.5	8.4	8.5*	-
Waukegan	8.0 - 8.5	8.2	8.0 - 8.5	8.3	7.9 - 8.5	8.2
North Chicago	8.1 - 8.5	8.2	- -	-	- -	-
Highland Park	8.1 - 8.5	8.2	8.0 - 8.6	8.3	8.0 - 8.6	8.3
Evanston	8.1 - 8.5	8.3	7.9 - 8.5	8.3	7.9 - 8.5	8.2
Chicago-Carter Harrison Crib	- -	-	8.3 - 8.5	8.4	8.4*	-
Chicago-Dunne Crib	- -	-	8.2 - 8.4	8.3	8.4*	-
Chicago-South	8.1 - 8.5	8.3	- -	-	- -	-
SWB-7 From:	7.7	8.1	7.7	8.1	7.7	8.1
Range To :	9.0	8.4	9.0	8.4	9.0	8.4

*Only one sample collected

DISSOLVED OXYGEN

Standards: Annual Average - not less than 90% saturation
Single Value - not less than 80% saturation

Dissolved oxygen levels were in general compliance with the standards in 1969.

Surface and bottom D.O. samples were obtained during boat sampling cruises. No D.O. samples were collected at the filtration plants. All of the surface values complied with the annual average standard. The annual average values of bottom samples at Waukegan and Highland Park did not meet this standard. One surface sample off Highland Park did not meet the single value standard. Additionally, two bottom samples from Waukegan and one bottom sample each from Highland Park and Evanston did not meet the single value standard. It should be noted that Lake Michigan is thermally stratified during part of the year, which leads to lowered dissolved oxygen levels near the lake bottom. All of the maximum values, both surface and bottom, indicated supersaturation.

TABLE 6

DISSOLVED OXYGEN LEVELS
(Percent Saturation)

LOCATION	SURFACE Max.	SURFACE Min.	SURFACE Annual Average	BOTTOM Max.	BOTTOM Min.	BOTTOM Annual Average
Zion	126	100	111	102	89	94
Waukegan	125	92	108	102	64	83
Highland Park	108	76	93	104	70	86
Evanston	108	92	99	106	76	93
Chicago-Carter Harrison Crib	110	99	105	109	94	102
Chicago-Dunne Crib	108	92	101	103	88	98
SWB Limit: Not less than		80	90		80	90

AMMONIA NITROGEN (Table 7) (A decomposition product of organic matter; an indication of recent sewage contamination)

Standards: Annual Average-0.02 mg/l
Single Daily Value or Average-0.05 mg/l

Ammonia nitrogen levels exceeded the open water standards during 1969.

Values from the filtration plants exceeded the annual average standard at all locations except at the Chicago-South plant. At the stations sampled by boat, only the Highland Park and the Carter Harrison Crib areas complied with the annual average and the single daily value standards. None of the four other stations, with values ranging from 0.10 mg/l to 0.50 mg/l, met the single daily value standard.

Although the standards were exceeded during 1969, the maximum and annual average values were somewhat lower than those found during 1968.

METHYLENE BLUE ACTIVE SUBSTANCE (Table 8) (An ingredient of detergents; toxic to fishes, causes undesirable tastes and produces unsightly, persistent foams)

Standards: Annual Average - not more than 0.05 mg/l
Single Daily Value or Average - not more than 0.20 mg/l

MBAS values were in general compliance with the standards in 1969.

Of the five filtration plants sampled in 1969, only the Waukegan plant exceeded the annual average and single daily value standards. However, the annual average and single daily values at the North Chicago, Highland Park and Evanston plants were at the maximum permissible limits.

MBAS values were slightly lower during 1969.

TABLE 7

AMMONIA NITROGEN CONCENTRATIONS
(Milligrams per liter)

LOCATION	MAXIMUM	MINIMUM	ANNUAL AVERAGE
Zion	0.10*	0.00*	0.03*
Waukegan	0.10*	0.00*	0.04*
	0.30	0.00	0.04
North Chicago	0.50	0.00	0.06
Highland Park	0.00*	0.00*	0.00*
	0.10	0.00	0.03
Evanston	0.20*	0.00*	0.04*
	0.50	0.00	0.10
Chicago-Carter Harrison Crib	0.00*	0.00*	0.00*
Chicago-Dunne Crib	0.10*	0.00*	0.03*
Chicago-South	0.10	0.00	0.02
SWB-7 Limits: Not more than	0.05		0.02

*Boat samples. Other data represent filtration plant samples.

TABLE 8

METHYLENE BLUE ACTIVE SUBSTANCE CONCENTRATIONS
(Milligrams per liter)

LOCATION	MAXIMUM	MINIMUM	ANNUAL AVERAGE
Waukegan	0.30	0.00	0.06
North Chicago	0.20	0.00	0.05
Highland Park	0.20	0.00	0.05
Evanston	0.20	0.00	0.05
Chicago-South	0.10	0.00	0.04
SWB-7 Limits: Not more than	0.20		0.05

CYANIDES (A toxic industrial waste)

Standard: Single value - not more than 0.025 mg/l

During 1969, there were no measurable amounts of cyanides recorded at any of the filtration plants. This is comparable to 1968, when no measurable amounts were recorded in the open waters.

FLUORIDES (Normally present in water; abnormal fluctuation generally an indication of industrial wastes)

Standards: Annual Average - not more than 1.0 mg/l
Single Daily Values or Average - not more than 1.3 mg/l

Fluoride levels in 1969 were in general compliance with the standards.

The annual average values were within the standard of all five filtration plants. The standard for single daily values was met at all plants except once at the North Chicago plant, which recorded a maximum value of 4.4 mg/l on March 3, 1969. There was no appreciable change in the levels of fluorides in the open waters from 1968 to 1969.

TABLE 9

FLUORIDE CONCENTRATIONS
(Milligrams per liter)

WATER FILTRATION PLANT	MAXIMUM	MINIMUM	ANNUAL AVERAGE
Waukegan	0.2	0.0	0.1
North Chicago	4.4	0.0	0.4
Highland Park	0.3	0.0	0.1
Evanston	0.2	0.0	0.1
Chicago-South	0.1	0.0	0.1
SWB-7 Limits: Not more than	1.3		1.0

DISSOLVED IRON (Usually An Industrial waste product when in significant amounts)
(Table 10)

Standards: Annual Average - not more than 0.15 mg/l
Single Daily Value or Average - not more than 0.30 mg/l

Dissolved iron levels in the open waters were in general compliance with the standards during 1969.

Samples for dissolved iron analyses were obtained at the municipal filtration plants and during boat cruises. The annual average concentration at each of the eight stations complied with the standard during 1969. Annual average values ranged from 0.05 mg/l to 0.12 mg/l. Samples collected on April 7, 1969 at Waukegan, North Chicago and Highland Park exceeded the single value standard.

During 1969, dissolved iron concentrations were appreciably lower than found during 1968.

TABLE 10

DISSOLVED IRON CONCENTRATIONS
(Milligrams per liter)

WATER FILTRATION PLANT	MAXIMUM	MINIMUM	ANNUAL AVERAGE
Zion	0.05*	0.05*	0.05*
Waukegan	0.10*	0.05*	0.06*
	0.70	0.05	0.12
North Chicago	0.40	0.05	0.09
Highland Park	0.05*	0.05*	0.05*
	0.50	0.05	0.10
Evanston	0.05*	0.05*	0.05*
	0.30	0.00	0.07
Chicago-Carter Harrison Crib	0.03*	0.05*	0.11*
Chicago-Dunne Crib	0.10*	0.05*	0.06*
Chicago-South	0.30	0.05	0.08
SWB-7 Limits: Not more than	0.30		0.15

*Boat samples. Other data represent filtration plant samples.

PHENOL-LIKE SUBSTANCES (An industrial waste product)

Standards: Annual Average - not more than 0.001 mg/l
Single Value - not more than 0.003 mg/l

The levels of phenols were in general compliance with the standards in 1969.

Samples were obtained during boat sampling surveys and at the municipal filtration plants. The samples collected at the filtration plants showed no measurable amounts of phenols. Samples collected by boat exceeded the single value standard once each at Zion, Waukegan, Highland Park and Evanston. Maximum values at these boat stations ranged from 0.006 mg/l at Zion and Waukegan to 0.008 mg/l at Highland Park and Evanston.

There was no appreciable change in the levels of phenols from 1968 to 1969.

CHLORIDES (A component of sewage, surface run-off, and industrial and agricultural wastes)

Standards: Through 1970, Annual Average - not more than 9 mg/l
Single Daily Value or Average - not more than 15 mg/l

Chloride levels in the open waters exceeded the standards during 1969.

The annual average chloride limit of 9 mg/l was exceeded at all five filtration plants. Annual average values ranged from 9.8 mg/l at the Highland Park and Chicago-South plants to 10 mg/l at the Waukegan, North Chicago and Evanston filtration plants.

The single daily value limit of 15 mg/l was not exceeded at any plant; a maximum value of 12 mg/l was recorded once each at Waukegan and Evanston.

In 1969, the concentrations of chlorides represented a slight deterioration in the quality of the open waters from 1968.

SULFATES (Commonly present in water; an abnormal fluctuation is usually an indication of industrial wastes)

Standards: Through 1970, Annual Average - not more than 24 mg/l
Single Daily Value or Average - not more than 50 mg/l

The concentrations of sulfates in the open waters complied with the standards during 1969.

The annual average standard and the single daily value limit were not exceeded at any plant. The annual average concentration at all five plants was 21 mg/l; the maximum single value recorded during 1969 was 29 mg/l.

During 1969, the levels of sulfates decreased at all stations.

FILTRABLE RESIDUE (Total dissolved solids)

Standards: Through 1970, Annual Average - not more than 165 mg/l
Single Daily Value or Average - not more than 200 mg/l

The levels of dissolved solids did not meet the standards in 1969.

The annual average standard was exceeded at the four North Shore filtration plants while only the Chicago-South plant met the standard. At all five plants, the annual average concentration increased slightly from 1968. No values exceeded the single daily value standard.

The levels of dissolved solids in the open waters increased slightly from 1968 to 1969.

TABLE 11

CHLORIDE, SULFATE AND FILTRABLE RESIDUE CONCENTRATIONS
(Milligrams per liter)

WATER FILTRATION PLANT	CHLORIDES	SULFATES	FILTRABLE RESIDUE
Waukegan	10	21	167
North Chicago	10	21	167
Highland Park	9.8	21	167
Evanston	10	21	167
Chicago-South	9.8	21	164
SWB-7 Limits: Not more than	9	24	165

TOTAL PHOSPHATES (A component of treated sewage, synthetic detergents and surface run-off)

Standards: Annual Average - not more than 0.03 mg/l
Single Daily Value or Average - not more than 0.04 mg/l

Total phosphate levels in the open waters did not meet the standards in 1969.

Samples were collected during boat sampling cruises and at the five filtration plants.

The annual average standard was exceeded at all of the sampling stations. Also, it was the rule rather than the exception for single values to exceed the single daily value standard. Single values ranged as high as 7.20 mg/l at North Chicago.

The levels of phosphates during 1969 increased slightly from 1968.

TABLE 12

PHOSPHATE CONCENTRATIONS
(Milligrams per liter)

LOCATION	Number of Samples	Number of Daily Values Exceeding Standard	Range of Values	Annual Average Standard
Zion	4*	3*	0.00 - 0.30*	0.18*
Waukegan	5*	3*	0.00 - 0.20*	0.18*
	11	9	0.00 - 0.50	0.17
North Chicago	12	9	0.00 - 7.20	0.72
Highland Park	5*	5*	0.10 - 0.30*	0.22*
	12	8	0.00 - 2.50	0.34
Evanston	5*	5*	0.00 - 0.40*	0.22*
	12	7	0.00 - 0.20	0.08
Chicago-Carter Harrison Crib	4*	3*	0.00 - 1.00*	0.35*
Chicago-Dunne Crib	4*	4*	0.10 - 0.20*	0.13*
Chicago-South	10	7	0.00 - 0.40	0.17
SWB-7 Limits: Not more than		0.04		0.03

*Boat samples. Other data represent filtration plant samples.

RADIONUCLIDES (Alpha and beta emissions; any abnormal deviation from background levels may be indicative of pollution from industrial sources, such as nuclear power plants, or of fall out)

Standard: Shall not be present in concentrations that will prevent meeting Public Health Service 1962 Drinking Water Standards after conventional treatment.

The standard is not considered to be in violation as long as the concentrations of dissolved alpha and gross beta emitters do not exceed 3 micro-microcuries per liter and 1,000 micro-microcuries per liter, respectively.

During 1969, the levels of radionuclides were in compliance with the Standard.

Except for an increase in the dissolved alpha value at Highland Park from zero micro-microcuries per liter in 1968 to 3 micro-microcuries per liter in 1969, the alpha and beta values were generally unchanged from 1968.

TABLE 13

RADIOACTIVITY LEVELS
(Micro-microcuries per liter)

WATER FILTRATION PLANT	Number of Samples Analyzed	Maximum Concentrations Alpha	Maximum Concentrations Beta	Average Concentrations Alpha	Average Concentrations Beta
Waukegan	10	1	5	0.3	4
North Chicago	10	1	5	0.2	3
Highland Park	11	3	8	0.5	4
Evanston	11	1	6	0.1	4
Chicago-South	9	0	5	0.0	4
SWB-7 Limits: Not more than		3	1,000		

PHYTOPLANKTON (Free-floating, microscopic plant organisms)

Although standards have not been established for phytoplankton, data on their relative abundance are of value in determining eutrophication trends within the lake.

The annual average phytoplankton densities at the North Shore filtration plants were lower in 1969 than in 1968. Phytoplankton densities at the Chicago-South plant increased slightly from 1968. The highest densities were recorded most often at the Evanston plant and are comparable to 1968 when the phytoplankton densities were also the highest in the Evanston vicinity. As in 1968, the lowest densities in 1969 were recorded at the Chicago-South plant. The highest count, 10,000 organisms per milliliter, occurred at Evanston on March 3, 1969.

TABLE 14

PHYTOPLANKTON AVERAGE DENSITIES
(Number of Organisms per milliliter)

LOCATION	WATER FILTRATION PLANT	BOAT SAMPLES Surface	BOAT SAMPLES Bottom
Zion	-	2,727	3,072
Waukegan	3,028	2,551	2,742
North Chicago	2,808	-	-
Highland Park	2,765	2,380	2,106
Evanston	3,284	1,732	2,815
Chicago-Carter Harrison Crib	-	1,946	3,303
Chicago-Dunne Crib	-	3,197	2,977
Chicago-South	2,378	-	-

SECCHI DISC MEASUREMENTS (A measure of light penetration)

Although standards have not been established for this parameter, Secchi disc measurements are a useful index for determining the degree of light penetration in water. The degree of light penetration is affected by the presence or absence of suspended and colloidal matter.

The areas of greatest light penetration were measured at the Authorized Dumping Grounds. This was as expected since this area is the farthest removed from near-shore influences. And, as expected, the areas of least light penetration were found within heavily industralized Calumet Harbor.

TABLE 15

SECCHI DISC MEASUREMENTS

LOCATION	MAXIMUM*	MINIMUM*	AVERAGE*
Zion	7.5	6.3	7.1
Waukegan	10.5	5.0	7.7
Highland Park	14.5	4.0	8.6
Evanston	13.5	4.2	9.2
Chicago-Carter Harrison Crib	10.5	5.3	7.6
Chicago-Dunne Crib	10.0	4.5	7.2
Dump Area at Northwest Corner	28.0	12.0	19.3
Dump Area at Southwest Corner	25.0	12.0	17.3
Calumet Harbor at State Line	2.5	2.3	2.4
Calumet Harbor at Mouth of Calumet River	3.0	3.0	3.0

*Expressed in feet.

U.S. ESTABLISHED DUMPING AREA WATER MONITORING

RESULTS AND EVALUATION

COLIFORM BACTERIA

The coliform bacteria levels at the Dumping Area were well within the standards for annual average and single daily values. The maximum value was one per 100 ml.

FECAL STREPTOCOCCI

Fecal Streptococci levels were in compliance with the standard. In the open waters, fecal streptococci levels may not exceed 25/100 ml.; the maximum recorded count was one per 100 ml.

TURBIDITY

Turbidity levels were in compliance with the standard. A maximum value of 10 Jackson Turbidity Units was recorded once.

ODOR

Odors were not present in water samples collected at the Dumping Area.

OIL

Visible floating oil was not observed during 1969.

FLOATING SOLIDS AND DEBRIS

Floating solids and debris were not observed at the Dumping Area.

TEMPERATURE

Temperature levels were well within the standard. The highest temperature recorded at the Dumping Area was 67°F. Surface maximum, minimum and average temperatures were slightly higher than the corresponding bottom values.

HYDROGEN ION CONCENTRATION (pH)

pH values complied with the standards. Single values ranged from 8.3 to 8.5, well within the 7.7 to 9.0 limits of the daily median standard. The annual average of 8.4 was the maximum permissible value.

DISSOLVED OXYGEN

The annual average and minimum single values were well above the minimum limit of the open water standard. All of the surface and bottom samples indicated a supersaturated condition.

AMMONIA NITROGEN

Measurable amounts of ammonia nitrogen were not recorded at the Dumping Area in 1969.

METHYLENE BLUE ACTIVE SUBSTANCE

The levels of MBAS complied with the standards. The annual average standard was not exceeded nor did any value exceed the standard for single daily values.

CHLORIDES

The levels of chlorides at the Dumping Area exceeded the standards. The annual average value of 10 mg/l exceeded the 9 mg/l standard. The maximum value (10 mg/l) did not exceed the standard for single daily values.

CYANIDES

During 1969, measurable amounts of cyanides were not recorded.

FLUORIDES

The Dumping Area was sampled for fluorides only once. This value, 0.2 mg/l, was well within the limit of the standard.

DISSOLVED IRON

The levels of dissolved iron met the standards. An iron concentration of 0.05 mg/l was found during each of the three sampling trips.

PHENOL-LIKE SUBSTANCES

Measurable amounts of phenols were not recorded at the Dumping Area.

SULFATES

Sulfate concentrations met the standards. The annual average value of 20 mg/l did not exceed the annual average standard. Also, the maximum recorded value, 22 mg/l, was well within the single value standard of 50 mg/l.

TOTAL PHOSPHATES

Phosphate concentrations exceeded the standards. The annual average of 0.05 mg/l exceeded the annual average standard while fifty percent of the samples exceeded the single value standard.

FILTRABLE RESIDUE (Total dissolved solids)

The levels of dissolved solids met the standards. No values exceeded either the annual average or the single daily value standards. The highest value, 163 mg/l, was within the single value standard of 200 mg/l.

RADIONUCLIDES

Four Dumping Area samples were analyzed for radioactivity levels. The levels of dissolved alpha and gross beta emitters in all of the samples were well within the standards.

PHYTOPLANKTON

Surface and bottom phytoplankton samples were collected. Phytoplankton densities were higher in the bottom samples than in the surface samples.

SECCHI DISC MEASUREMENTS (See Table 15)

Table 16

WATER QUALITY AT THE U. S. ESTABLISHED DUMPING AREA

PARAMETER	MAXIMUM	MINIMUM	ANNUAL AVERAGE	SWB-7 ANNUAL AVERAGE STANDARD
Coliform Bacteria (No./100 ml)	1	1	1	Not more than 200
Fecal Streptococci (No./100 ml)	1	1	1	Not more than 25
Turbidity (J.T.U.)	10	3	6	---
Temperature (°F)				
Surface	67	49	57	Not more than 85
Bottom	65	45	53	
pH	8.5	8.3	8.4	Within range 8.1-8.4
Dissolved Oxygen (% Saturation)				
Surface	110	104	108	Not less than 90
Bottom	105	103	104	
MBAS (mg/l)	0.10	0.00	0.03	Not more than 0.05
Chlorides (mg/l)	10	9	10	Not more than 9
Dissolved Iron (mg/l)	0.05	0.05	0.05	Not more than 0.15
Sulfates (mg/l)	22	18	20	Not more than 24
Total Phosphates (mg/l)	0.10	0.00	0.05	Not more than 0.03
Filtrable Residue (mg/l)	163	160	161	Not more than 165
Radionuclides (mmc/l)				
Alpha	0	0	0	Not more than 3
Beta	5	3	4	Not more than 1,000
Phytoplankton (No./l)				
Surface	2,280	500	1,162	---
Bottom	2,736	500	1,390	---

CALUMET HARBOR WATER MONITORING

RESULTS AND EVALUATION

COLIFORM BACTERIA

Standards: Annual Average (Arithmetic) - not more than 2,000 per 100 ml.
Single Daily Value or Average - not more than 5,000 per 100 ml.

The coliform bacteria levels met the standards.

The annual average and maximum single values were well within the limits of the standards. The maximum value, 380 per 100 ml., was recorded at the State Line station.

FECAL STREPTOCOCCI

Standard: Not more than 100/100 ml.

The maximum value recorded at both sampling stations was only 10 per 100 ml.

TURBIDITY

Standard: No turbidity of other than natural origin that will cause substantial visible contrast with the natural appearance of water.

The annual average turbidity levels at the two Calumet Harbor stations were low. Values above ten turbidity units were recorded only once each at the State Line and Calumet River stations.

ODOR

Standard: No obnoxious odor of other than natural origin.

No unusual odors were noted in water samples collected within the Calumet Harbor Basin.

TEMPERATURE

Standard: Not more than 85°F.

Temperature levels met the standard. Maximum values of 74°F and 72°F were recorded at the State Line and Calumet River stations, respectively.

OIL

Standard: Substantially free of visible floating oil.

Floating oil was observed at the State Line station consistently. The mouth of the Calumet River was substantially free of visible floating oil.

FLOATING SOLIDS AND DEBRIS

Standard: Substantially free of floating solids and debris from other than natural sources.

Floating solids and debris were not observed within the Calumet Harbor Basin.

HYDROGEN ION CONCENTRATION (pH)

Standard: Annual Median - within range 8.0 - 8.5
Daily Median - within range 7.5 - 9.0

The pH values in Calumet Harbor met the standards. Minimum and maximum values at both stations were within the daily median range. The annual average value of 8.2 at both stations fell within the prescribed annual median range.

DISSOLVED OXYGEN

Standards: Annual Average - not less than 80% saturation.
Single Daily Value or Average - not less than 65% saturation

The levels of dissolved oxygen met the standards. The minimum single value at both stations was 84% saturation, well above the minimum requirements of the single daily value standard. In addition, the annual average values of 91% and 90% saturation at the State Line and Calumet River stations, respectively, were well above the minimum prescribed annual average limit.

AMMONIA NITROGEN

Standards: Annual Average - 0.05
Single Daily Value or Average - 0.12

Measurable amounts of ammonia nitrogen were not detected within the Calumet Harbor Basin.

METHYLENE BLUE ACTIVE SUBSTANCE

Standard: Annual Average - not more than 0.10 mg/l
Single Daily Value or Average - not more than 0.30 mg/l

The annual average MBAS value at the State Line station exceeded the annual average standard. In addition, the maximum single value recorded at this station, 0.30 mg/l, was the maximum permissible for single daily values. The annual average concentration at the Calumet River station, while meeting the standard, was at the permissible maximum.

CHLORIDES

Standards: Through 1970, Annual Average - not more than 18 mg/l
Single Daily Value or Average - not more than 30 mg/l

The levels of chlorides were within the standards in the Calumet Harbor Basin. Annual average values were 10 mg/l and 11 mg/l at the State Line and Calumet River stations, respectively. The maximum single value was 12 mg/l at the Calumet River station; this was well within the single value standard.

CYANIDES

Standard: Single Value - less than 0.1 mg/l

There were no measurable amounts of cyanides recorded in the Calumet Harbor Basin.

FLUORIDES

Standards: Annual Average - not more than 1.0 mg/l
Single Daily Value or Average - not more than 1.3 mg/l

Fluoride levels in the Calumet Harbor Basin were within the standards.

Annual average and maximum single values were slightly higher at the State Line station than at the Calumet River station.

DISSOLVED IRON

Standards: Annual Average - not more than 0.15 mg/l
Single Daily Value or Average - not more than 0.30 mg/l

The levels of dissolved iron were well within the standards. The maximum value recorded at both stations was 0.05 mg/l.

PHENOL-LIKE SUBSTANCES

Standards: Annual Average - not more than 0.002 mg/l
Single Value or Average - not more than 0.005 mg/l

There were no measurable amounts of phenols.

SULFATES

Standards: Through 1970, Annual Average - not more than 36 mg/l
Single Daily Value or Average - not more than 75 mg/l

Sulfate levels met the standards. Annual average values were 22 mg/l and 21 mg/l at the State Line and Calumet River stations, respectively. The highest single value, 24 mg/l, was recorded at the Calumet River station.

TOTAL PHOSPHATES

Standards: Annual Average - not more than 0.05 mg/l
Single Daily Value or Average - not more than 0.10 mg/l

The annual average and single value standards were exceeded at the State Line station. The single value standard was exceeded once at the State Line station, and the maximum value at the Calumet River station, while still within the limit, was at the maximum permissible.

FILTRABLE RESIDUE (Total Dissolved Solids)

Standards: Through 1970, Annual Average - not more than 190 mg/l
Single Daily Value or Average - not more than 230 mg/l

The concentrations of dissolved solids were within the standards during 1969. Annual average values at the State Line and Calumet River stations were 172 mg/l and 170 mg/l, respectively. The highest single value, 178 mg/l, at the State Line station was well within the single value standard.

RADIONUCLIDES

Standard: Shall not be present in concentrations that will prevent meeting PHS 1962 Drinking Water Standards after conventional treatment.

The standard is not considered to be in violation as long as the concentrations of dissolved alpha and gross beta emitters do not exceed 3 micro-microcuries per liter and 1,000 micro-microcuries per liter, respectively.

Three water samples from the State Line station were analyzed for radionuclides. Alpha and beta radioactivity levels were well within the limits specified in the standard. Two samples collected at the Calumet River station for radioactivity determination were also found to be well within the standards.

SECCHI DISC MEASUREMENTS (See Table 15)

Table 17

WATER QUALITY AT THE STATE LINE STATION IN CALUMET HARBOR BASIN

PARAMETER	MAXIMUM	MINIMUM	ANNUAL AVERAGE	SWB-15 ANNUAL AVERAGE STANDARD
Coliform Bacteria (No./100 ml)	380	130	213	Not more than 2,000
Fecal Streptococci (No./100 ml)	10	4	7	Not more than 100
Turbidity (J.T.U.)	17	6	10	---
Temperature (°F)	74	60	66	Not more than 85
pH	8.3	8.2	8.2	Within range 8.0-8.5
Dissolved Oxygen (% Saturation)	95	84	91	Not less than 80
MBAS (mg/l)	0.30	0.00	0.20	Not more than 0.10
Chlorides (mg/l)	11	9	10	Not more than 18
Fluorides (mg/l)	0.5	0.0	0.3	Not more than 1.0
Dissolved Iron (mg/l)	0.05	0.05	0.05	Not more than 0.15
Sulfates (mg/l)	25	19	22	Not more than 36
Total Phosphates (mg/l)	0.80	0.00	0.30	Not more than 0.05
Filtrable Residue (mg/l)	178	167	172	Not more than 190
Radionuclides (mmc/l)				
Alpha	0	0	0	Not more than 3
Beta	6	4	5	Not more than 1,000

Table 18

WATER QUALITY AT THE CALUMET RIVER STATION IN CALUMET HARBOR BASIN

PARAMETER	MAXIMUM	MINIMUM	ANNUAL AVERAGE	SWB-15 ANNUAL AVERAGE STANDARD
Coliform Bacteria (No./100 ml)	320	160	217	Not more than 2,000
Fecal Streptococci (No./100 ml)	10	6	7	Not more than 100
Turbidity (J.T.U.)	13	5	9	---
Temperature (°F)	72	54	64	Not more than 85
pH	8.3	8.2	8.2	Within range 8.2-8.5
Dissolved Oxygen (% Saturation)	95	84	90	Not less than 80
MBAS (mg/l)	0.20	0.00	0.10	Not more than 0.10
Chlorides (mg/l)	12	10	11	Not more than 18
Fluorides (mg/l)	0.2	0.0	0.1	Not more than 1.0
Dissolved Iron (mg/l)	0.05	0.05	0.05	Not more than 0.15
Sulfates (mg/l)	24	19	21	Not more than 36
Total Phosphates (mg/l)	0.10	0.00	0.03	Not more than 0.05
Filtrable Residue (mg/l)	172	167	170	Not more than 190
Radionuclides (mmc/l)				
Alpha	0	0	0	Not more than 3
Beta	5	5	5	Not more than 1,000

LAKE BED SURVEY

GENERAL INFORMATION

Lake Michigan Open Water Standards, SWB-7, require that the Lake Michigan bottom deposits be "Substantially free of contaminants that will: (1) adversely alter the composition of the bottom fauna; (2) interfere with the spawning of fish or their eggs; (3) adversely alter the physical or chemical nature of the bottom."

Ten boat cruises were made to obtain data regarding the composition of the bottom macroinvertebrate population. The areas surveyed during the lake bed sampling are shown in Figures 1 and 2. Tables 19, 20 and 21 list the organisms collected at the various stations.

Petersen and Ponar dredges were used to collect bottom organisms. Macroinvertebrate organisms thus collected were preserved for later identification in the laboratory.

The classification system employed by the Illinois Department of Public Health, which is based on the relative numbers of organisms and species present in a given area, was used to evaluate the quality of the bottom deposits at the various stations.

A well-balanced bottom population of macroinvertebrate organisms will include a variety of species, including those that are sensitive to pollution and those that can exist in degraded environments. An increase in the amount of pollution present at a given site will cause the balance to shift so as to include more of the types of organisms that are adapted to functioning in polluted environments. Carried to an extreme, such environments would support only pollution-tolerant organisms such as sludgeworms.

RESULTS AND EVALUATION OF MONITORING

Samples of bottom deposits were dredged from sixty lake bed stations in the area from Zion south to Calumet Harbor as shown in Figures 1 and 2. The presence of large rocks at three stations (19, 34 and 40) prevented the collection of bottom organisms. Therefore, only the data relating to fifty-seven stations were included in the evaluations. The area between Waukegan and the Great Lakes Naval Training Center was not surveyed in 1969 due to military use of the North Chicago firing range.

Four general areas of biological degradation were found in areas off shore from: (1) Great Lakes Training Center to Lake Bluff; (2) Highland Park to Winnetka; (3) Diversey Harbor to Grand Avenue; and (4) 79th Street.

In the Great Lakes Naval Training Center to Lake Bluff area, the most severely polluted site was found within the Great Lake Naval Training Center Harbor, Station 8, where sludgeworm populations ranged up to 10,000 per square foot. Two other stations in this area were less severely polluted.

In the Highland Park to Winnetka area, the most severly polluted site was found at Station 28, where the sludgeworm population was 2,500 per square foot. Lesser degrees of pollution were found at seven other stations.

In the Chicago area, northwest of the Carter Harrison crib, sludgeworm populations of 2,967 per square foot were found at Station 43. Lesser degrees of pollution were found at two other stations within this area.

Lake bed deposits at stations 58, 59 and 60, in the area off 79th Street, supported sludgeworm populations ranging from 137 to 171 per square foot. Sludgeworm populations in excess of 100 per square foot were considered indicative of a polluted environment; it appears that wastes from industries in the Calumet area inhibit the establishment of a large bottom population in this area. Within the Calumet Harbor Basin, dredge samples collected near the 87th Street breakwater showed evidence that the bottom contained appreciable quantities of rust pellets, black oily sludge and detritus.

At the mouth of the Calumet River, only very limited numbers of live organisms were found. An abundance of dead and decayed organisms and empty clam and snail shells indicated evidence of chemical pollution. Lesser degrees of pollution were found at two other stations directly northwest and northeast of the Dunne crib.

Except for the Calumet region stations, the bottom deposits in the other polluted areas cited above, especially Stations 8, 28 and 43, consisted primarily of grey muck and silt. This type of organically enriched "sludge" bottom is typical of a severely polluted environment. Characteristically, this type of bottom will support thousands of sludgeworms per square foot. Such bottom deposits are not typical of the Lake Michigan bottom which, in its natural state, consists of sand, pebbles, clay, mud and rocks.

Other areas representative of an unbalanced bottom population were found at fourteen dredge stations, twelve of which were found along the North Shore portion of the lake. If the unbalanced and polluted stations are considered as a group, 22 or 38.6% were found in the area from the Great Lakes Naval Training Center south to Evanston.

A six-station area off Waukegan and scattered areas off shore from the City of Chicago represented the only substantial contiguous areas found which supported a balanced bottom population.

Within the Lake County portion of Lake Michigan, sewage effluents from ten sewage treatment plants discharge into the lake. Seven of these plants are operated by the North Shore Sanitary District, and the other three by military installations at Fort Sheridan, Camp Logan and the Great Lakes Naval Training Center. Except as noted subsequently, limited sampling in 1968 did not clearly identify areas of organically enriched bottom sediments specifically attributable to these facilities; however, the nutritive qualities of these effluents may well be a contributing factor in supporting and sustaining the ecologically degraded lake bottom along the North Shore.

In 1968, one limited sampling survey did define an area of pollution adjacent to the North Chicago sewage treatment plant outfall. In this instance, organic pollution was measured at a distance of 250 to 500 yards off shore from the outfall. Limited dredging in 1968 also suggested areas of pollution off shore from Highwood, Glencoe and Winnetka. This was confirmed during the 1969 sampling survey as indicated above.

Samples collected at Stations 38, 39, 46, 50 and 56, all off shore from the City of Chicago, were found to be practically devoid of any organisms.

In summary, nineteen stations supported balanced populations, fourteen supported unbalanced populations and nineteen supported pollution-tolerant populations. Therefore, 57.9% of the stations were indicative of biologically degraded environments, not in compliance with the lake bed standard.

Table 19

BOTTOM ORGANISMS COLLECTED OFFSHORE FROM ZION TO HIGHWOOD

(No. of organisms per sq. ft.)

	Pollution-Intolerant Species - ranging to - Pollution Tolerant Species											
STATION	Mayfly	Caddisfly	Scuds	Water Fleas	Water Mites	Aquatic Sow Bugs	Clams	Snails	Flatworms	Midges	Leeches	Sludgeworms
1			17					16		7		41
2			346				34	27		2		145
3			275				150	4		1		247
4			755			1	128			5		210
5			259				35	37		7		63
6			331				73	11		7		33
7			660				25			5		21
8							50			5		10,000
9			6				1			1	1	5
10			121							10		36
11			5				4			3		9
12			+		1		5		+	10	+	33
13			5			2					1	
14			9			3		1		107	1	36
15			15							1		24
16			16					3		1	1	10
17			3			4		42		3	1	3
18			11					1		121	2	7
19	Rocky Bottom - satisfactory samples could not be collected											
20			1							40		19

Note: Station Locations Shown in Figure 1

+ Less than one organism per square foot

Table 20

BOTTOM ORGANISMS COLLECTED OFFSHORE FROM HIGHLAND PARK TO EVANSTON

(No. of organisms per sq. ft.)

Pollution-Intolerant Species - ranging to - Pollution Tolerant Species

STATION	Mayfly	Caddisfly	Scuds	Water Fleas	Water Mites	Aquatic Sow Bugs	Clams	Snails	Flatworms	Midges	Leeches	Sludgeworms
21			3				1	1		2		11
22								27				
23			39				4					21
24								2			2	
25								25				
26			1								21	
27						2		1				
28		1	1				1			50		2,500
29								2		3		4
30		1						2		1		1
31			4				1	19	1	1		1
32			1							1		+
33										3		9
34		Rocky Bottom - satisfactory samples could not be collected										
35			3					14				2
36			16	7		1	5	4		1	1	12

Note: Station Locations Shown in Figure 1

+ Less than one organism per square foot

Table 21

BOTTOM ORGANISMS COLLECTED OFFSHORE FROM CHICAGO

(No. of organisms per sq. ft.)

STATION	Pollution-Intolerant Species - ranging to - Pollution Tolerant Species											
	Mayfly	Caddisfly	Scuds	Water Fleas	Water Mites	Aquatic Sow Bugs	Clams	Snails	Flatworms	Midges	Leeches	Sludgeworms
37	+	+	14				1	23	5	1	1	2
38			1							1		
39							1					
40	Rocky Bottom - satisfactory samples could not be collected											
41			56									1
42			4									1
43							40				7	2,967
44			36				1			3	2	27
45								1		3	1	151
46												1
47												18
48			15							2		4
49			29				11	3	3	34		21
50								1				
51			74				1			2	1	5
52			11				21	33	13	7	13	10
53			108				9					4
54			11							1	3	40
55			4				2	5				31
56							2					
57			119				4			3		20
58			4					39		2	2	171
59							8	2			27	168
60										1	1	127

Note: Station Location Shown In Figure 2

+ Less than one organism per square foot

ENFORCEMENT, LEGISLATIVE AND REGULATORY ACTION

The following is a brief summary of enforcement, legislative and regulatory actions taken by the State of Illinois Sanitary Water Board and the Federal Government, to prevent, control and abate pollution of Lake Michigan.

1. The Lake Michigan - Calumet Area Federal Enforcement Conference (Illinois-Indiana) was held in Chicago, March 2 - 9, 1965. The Conference established December 31, 1968 as the deadline for the municipalities and industries in the area to construct necessary pollution control facilities.

   During the reconvened session on August 26, 1969, it was reported that several of the industries in the Calumet-Gary, Indiana area had not been able to complete necessary facilities; extensions to various dates up to June 1970 were granted. U. S. Steel Corporation (South Works) is scheduled to complete treatment facilities or to divert flow from Lake Michigan prior to December 31, 1970. Pollution of Lake Michigan still results from storm overflows from several municipal combined sewer systems in northwestern Indiana. Correction of these storm overflows is scheduled for completion by 1977.

2. The Lake Michigan - Four State (Illinois, Indiana, Michigan and Wisconsin) Federal Enforcement Conference was held in Chicago in January and February, 1968. The pollution control agencies in the four states and the Federal agency agreed upon a time schedule for construction of control facilities needed by the municipalities and industries to protect Lake Michigan. Programs were also established for controlling discharge of pollution from watercraft, reduction of phosphate in sewage plant effluents, control of combined sewer overflows, prohibiting dumping of pollutional materials in the lake, disinfection of sewage works effluents, and monitoring of lake water quality.

   Progress reports were presented at the second session on February 25, 1969 and at the third session on March 31, 1970. In general, the state enforcement agencies and the affected municipalities and industries are proceeding to implement control programs and to provide necessary treatment facilities, pursuant to the recommendations developed during the First Session.

   Present construction schedules call for providing adequate treatment or diversion out of the Lake Michigan watershed of all municipal and industrial wastes originating in Illinois presently tributary to Lake Michigan, by December, 1972, the deadline date established by the Conference.

3. In January, 1968 the U. S. Department of Interior approved the Water Quality Standards for Lake Michigan (Rules and Regulations, SWB-7) adopted by the Illinois Sanitary Water Board. Water Quality Standards for the Calumet River (included in Rules and Regulations, SWB-15) were also adopted and approved. Under certain infrequent storm conditions, the Calumet River can reverse and flow into the lake.

4. Senate Bill 1794, passed by the 75th General Assembly, effective October 30, 1967 prohibits the issuance of a permit for depositing any material or refuse into Lake Michigan except with the concurrence of the Illinois Sanitary Water Board. To date, the Board has only approved issuance of permits for placement of non-pollutional materials such as steel sheet piling, concrete structures or clean sand.

5. The twelve municipalities in Illinois operating public water supply filtration plants were notified during October, 1969 that filter backwash was considered a pollutant (SWB Technical Resease 20-21) and that adequate treatment of backwash water would have to be provided prior to discharge to the lake; this is to be accomplished by July, 1972. The Federal Water Quality Administration was requested to secure similar compliance by the military establishments (Fort Sheridan and the Great Lakes Naval Training Station).

6. Rules and Regulations, SWB-19, for the disposal of sewage and wastes from watercraft were adopted by the Illinois Sanitary Water Board on July 2, 1968 and became effective January 1, 1970. In essence, these rules and regulations require that watercraft must have holding tanks or incinerators for toilet wastes. Discharge of wastes is prohibited unless approved type treatment facilities are provided; to date, no approvals of treatment facilities have been granted.

7. An Act to prevent the contamination of water and environment by regulating, restricting, or prohibiting the sale, use or application of pesticides was passed by the 76th General Assembly and approved on June 25, 1969. Pursuant to authority granted in this Act, the Illinois Department of Public Health issued regulations prohibiting the sale, use or application of DDT except when there is an immediate and serious health threat.

SEWAGE TREATMENT PLANTS IN ILLINOIS DISCHARGING TO LAKE MICHIGAN

All seven municipal sewage treatment plants discharging to Lake Michigan in Illinois are within the North Shore Sanitary District (NSSD), which extends from the Illinois - Wisconsin State line south to Cook County. All of the municipalities in Cook County adjacent to Lake Michigan are served by the Metropolitan Sanitary District of Greater Chicago interceptor sewer system and sewage treatment facilities, which discharge to the Illinois River watershed.

Of the seven municipal plants, five located in Lake Forest, Lake Bluff and Highland Park provide only primary treatment (sedimentation) and disinfection of sewage prior to discharge to the lake. The Waukegan and North Chicago plants provide primary and secondary treatment (activated sludge process or trickling filter) and disinfection. All of these seven plants are operating at or in excess of their design capacities resulting in the discharge of inadequately treated waste, particularly during periods of rain or thaw.

The North Shore Sanitary District is engaged in a $60,000,000 construction program. When completed, the high quality effluent to be produced by the proposed facilities will be discharged to the Illinois River watershed, with no flow to Lake Michigan. The first phase of this program for which the voters in the District approved a General Obligation Bond Issue of $35,000,000, will provide for the diversion of the Lake Bluff, the Lake Forest and the three Highland Park primary plant effluents from Lake Michigan to the Clavey Road sewage treatment plant which discharges to the Skokie River. This first phase also provides for diversion of the North Chicago plant effluent to a proposed sewage treatment works at Gurnee and for expansion and improvement of the Waukegan sewage treatment works, including phosphate reduction, all by 1972. The Waukegan sewage treatment works will continue to discharge to the lake, unless and until the District can fund the entire proposed $60,000,000 project. Following certification by the Sanitary Water Board, the District was offered a Federal Grant of $11,550,000 on April 22, 1970. The District's plans call for all improvements in the first phase to be placed under construction during 1970 and for completion by July, 1972. Problems in securing zoning approvals and easements may delay the scheduled completion date by as much as one year.

The North Shore Sanitary District is presently installing interim chlorination facilities for disinfection of excess storm flows from the Lake Bluff, Lake Forest and Highland Park sanitary sewer systems which presently exceed the capacity of and bypass the existing treatment facilities and discharge directly to the lake. Following completion of the diversion facilities described above, the existing primary sedimentation and disinfection facilities will be kept on a standby basis for flows from Lake Bluff, Lake Forest and Highland Park which occur during very intense storms and may exceed the capacity of the diversion facilities.

Three sewage treatment plants serving military installations (Camp Logan, Great Lakes and Fort Sheridan) also discharge to the lake. All three plants provide secondary treatment and disinfection of the waste flows. The military authorities are under orders by the President of the United States to provide necessary treatment by 1972. Negotiations to connect to NSSD facilities and to, thereby, discontinue discharge to Lake Michigan are underway.

INDUSTRIES IN ILLINOIS DISCHARGING TO LAKE MICHIGAN

No industries in Illinois discharge domestic wastes to Lake Michigan. All of this flow goes to the Metropolitan Sanitary District of Greater Chicago (MSDGC) and the North Shore Sanitary District (NSSD) sewer systems and sewage treatment works.

The industries in Lake County, tributary to Lake Michigan, are located in the Waukegan-North Shore area. All of the industries discharge process wastes to the sewer systems which discharge to the NSSD Waukegan and North Chicago sewage treatment works, except as listed below.

> ABBOTT LABORATORIES (manufactures antibiotics, chemical drugs and pharmaceuticals). Major improvements at the Abbott industrial waste treatment works were completed during April, 1969. However, it has been determined that additional facilities are necessary in order to attain consistent performance needed to comply with Sanitary Water Board effluent quality criteria. These additional facilities estimated to cost $2,500,000, are scheduled for completion by December 1971.

U. S. STEEL CORPORATION, WAUKEGAN WORKS (produces carbon steel and stainless steel wire, springs, and coated wire). Hauling of waste acid to a disposal well at their Gary, Indiana, plant and in-plant improvements at the Waukegan Works have resulted in a very major reduction of wastes discharged to the lake. However, the discharges to Lake Michigan are still not in complete compliance with Sanitary Water Board requirements. Additional improvements are to be completed by December, 1971.

COMMONWEALTH EDISON COMPANY (Fossil fuel electric generating station). Heated cooling water is returned to the lake. There is presently no known adverse effect.

FANSTEEL METALLURGICAL CORPORATION (processes tungsten, molybdenum and tantalum and produces electrical contacts, rectifiers, capacitors and chemical plant equipment). Wastes, discharged to Pettibone Creek about one mile from Lake Michigan, occasionally contain constituents in concentrations in excess of limits established by the Sanitary Water Board. In-plant improvements are being made. Fansteel is also negotiating with the North Shore Sanitary District to discharge these wastes to the District facilities and to, thereby, divert all this flow out of the Lake Michigan watershed. These programs are to be completed prior to 1972.

OUTBOARD MARINE CORPORATION (manufacturers of boat motors). Effluent from oil interceptors, discharged to Waukegan Harbor and thru ditch to lake, has been in compliance with effluent quality limits. Plating wastes are discharged to the NSSD treatment facilities.

U. S. STEEL CORPORATION, SOUTH WORKS - Plant has discharges to Lake Michigan and to the Calumet River. Recycle of waste water in structural mill system is scheduled by May 1, 1972. Improvements to rolling mill scale pits are scheduled for September, 1970 completion. Elimination of No. 9 outfall to Lake Michigan, by recycle of furnace gas wash water, is scheduled for December 1970. These improvements are planned to place the plant discharge in compliance with Sanitary Water Board effluent quality guidelines by December 31, 1970.

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

All sanitary, industrial and storm flows from the area adjacent to Lake Michigan within Cook County are collected by the Metropolitan Sanitary District of Greater Chicago. Chicago, the North Shore municipalities in Cook County and the adjacent western suburbs, which cover an area of about 300 square miles, are served by combined sewers which discharge to the District's three major treatment plants. Effluents from these sewage treatment plants and combined sewer overflows, bypassed to the streams and canals during and following storms, are routed to the river and canal system which is tributary to the Illinois River and, therefore, do not enter Lake Michigan. Back flow from the river and canal system is controlled by lock-and-dam facilities located at the Wilmette pumping station, at the mouth of the Chicago River, and at the O'Brien Lock, on the Calumet River, directly south of Lake Calumet.

During high intensity rainfall, and particularly when rainfall is general throughout the Chicagoland area, water levels rise rapidly in the Chicago River and Calumet River and Calumet River systems. In order to prevent excessive flood damage, the Metropolitan Sanitary District of Greater Chicago has to open one or more of the three control locks, thereby, permitting back flow of polluted river water into Lake Michigan. The last such situation occurred on August 16, 1968, and caused the various responsible authorities to close Chicago area beaches for four days.

The MSDGC maintains an alert system in order to regulate the Lockport control facilities, so as to prevent or to minimize back flow into the lake. Present drainage structures do not permit adequate control. The City of Chicago, the MSDGC and the Illinois Division of Waterways have each developed engineering projects intended to resolve the drainage problem. In many respects, these projects are compatible. A coordinated final plan should be adopted, since each agency must provide part of the structures and facilities needed.

During severe rainfall conditions, the MSDGC pump station at 95th Street and South Chicago Avenue discharges combined sanitary-storm flow to the Calumet River. Chlorination facilities are operated to disinfect these discharges. These flows do not reach Lake Michigan except under unusual rainfall or lake level conditions.

LINCOLN PARK GUN CLUB

The Lincoln Park Gun Club firing range extends out into Lake Michigan. Approximately one million clay discs (pigeons) are expended in a year, thus at least one million shotgun rounds are also expended. The clay discs, plastic shot cups and the lead pellets from the shotgun shells enter the lake. The lead and clay sinks to the lake bed. It is estimated that 50,000 pounds of lead and 250,000 pounds of clay fall into the lake in a year. Periodically, lead has been salvaged by hydraulic mining. The plastic shot cups float and wash onto the beaches. In addition to the deposit of solids in the lake and the minor nuisance of floating particles on the beaches, the possible effect of the lead shot on water quality and aquatic life needs to be studied and evaluated.

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